SCIENCE

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THE ROYAL BOTANIC GARDENS AT KEW

THE recent establishment of the New York Botanical Garden, following so closely the development of the Missouri Botanical Garden, through the private munificence of Henry Shaw, and the evident tendency in American cities to establish each its own garden as a means of public pleasure and education, leads one to turn to the Old World, where such institutions are no longer a novelty. There is certain to be in the near future in America an awakening of interest in this feature of popular education, and we predict that the next quarter of a century will see them organized as a part of the park system of every city of importance and as a part of the equipment of every university that merits the name and rank.

Passing by the botanical gardens of the Italian cities, some of which are the oldest establishments of the kind in the world, dating back to the fifteenth century, and the less considerable establishments at Berlin and Paris, it is natural to turn to the largest and in many respects the most important of them all, because of its wide reaching influence, coextensive with British colonization itself. Of English botanical gardens those at Oxford and Cambridge, while smaller than Kew, are much older, and yet their influence largely pertains to the university towns and the universities that foster them, while Kew Garden, far from being local or simply national, is in-

tercolonial and international in its character and influence.

Kew Garden is involved in the history of English royalty, for not only is it situated in the heart of historic England, but itself forms a part of that history, being one of that royal series of palaces and parks that from time to time have bordered the Thames from Windsor to Westminster and have made the very region historic. Of this series, Kew with its gardens has been gradually given to the nation by the crown. Westminster ceased to be a royal residence with the bluff King Hal and his tender but well-beloved son; the glories of Richmond Palace as a royal residence ended with the giddy but brilliant Virgin Queen, and today only a vestige remains of Richmond's former greatness; Hampton Court flourished with Queen Anne and William and Mary; Kew's brief period closed with the decadence of the third Georgian reign, when the poor king, bereft of his colonies and finally stricken with disordered mind, was kept here in retirement during the long regency; of all the series, Windsor alone, oldest of all, remains a royal residence.

While the public Kew Garden has been established for less than sixty years, the real existence of Kew as a royal botanic garden dates back to the days of the good Princess Augusta, widow of Frederick, Prince of Wales, son of George the Second, and for a long period prior to this a large number of plants from various parts of the world had been under cultivation, and the whole area now occupied by the garden and arboretum was a private royal park with an abundance of native and cultivated trees; even in the time of Charles the Second the collection of plants was so considerable as to attract much attention, and Kew was regarded as one of the finest gardens in the British Isles. Erasmus Darwin, grandfather of the famous naturalist, sung its praises in his day:

> "So sits enthroned in vegetable pride
> Imperial Kew, by Thames' glittering side;
> Obedient sails from realms unfurrowed bring
> For her the unnamed progeny of Spring."

Soon after 1760 the Princess Augusta, mother of George the Third, with the influence of Lord Bute, himself a botanist of some note, called William Aiton, a Scottish gardener botanist, to take charge of the botanic garden. Every botanist is familiar with the *Hortus Kewensis*, which Aiton published in 1789, in which he gave an account of all the 5,500 species of plants growing at Kew, some of which had never before been described; among these were a considerable number of our common American wild flowers and ferns, including some of our common violets and trilliums.* The great number of species of plants described in this work gives some clue to the early growth of Kew Gardens, but within the twenty-five years following Aiton's publication the activity in securing new plants was so great that this number was doubled.

On the accession of the present sovereign, the purpose of opening the gardens to the public was carried into execution, and in 1841, Sir William Hooker, a distinguished botanist from Edinburgh, was called to the post of Director, and the gardens were presented to the nation.

Only a small part of the present area—that immediately surrounding the present Temple of the Sun—formed the original public garden, but gradually more and more passed over to the nation until now some 250 acres are included in the public garden, embracing all the former royal park at Kew except the immediate surroundings of Kew Palace and the wild woods immedi-

* This must not be confused with the earlier *Hortus Kewensis* of Hill, published in 1768, nor the second edition published by Aiton's son in 1813. Hill's catalogue named 488 hardy trees and shrubs, some 200 tender shrubs and over 2,700 herbaceous plants. In 1814 the total number of plants under cultivation exceeded 11,000.

ately about the Queen's cottage. Sir William Hooker died in 1866 and was succeeded by his son, Sir Joseph D. Hooker, also an eminent botanist, who still has his room in the herbarium and at 81 is yet active and enthusiastic in botanical work. He resigned his post as Director in 1885, and was succeeded by Dr. W. T. Thiselton-Dyer, who for some time previously had occupied the position of Assistant Director. It is needless to say to those who have watched the growth and widening influence of Kew in the past few years that much of the present development and much of the system manifest in its management, and, above all, its widening influence, is due to Dr. Dyer's versatility and ability as a Director. For ten years past he has been ably seconded in the management of the garden by Dr. Daniel Morris, whose colonial experience in Ceylon and Jamaica, and wide travel throughout the world, has enabled him to direct wisely the colonial policy of the garden. Many New Yorkers will recall his visit here in 1895, and the managers of our own garden owe much to his kindly advice and suggestions on their plans, rendered after an extended visit to Bronx Park.

Kew Gardens are located on the Surrey side of the Thames, on the line of omnibuses leading from London to Richmond and Hampton Court. The seventh mile post from Hyde Park corner is just beyond the Unicorn Gate. Two railways, besides the Thames steamers and omnibuses, connect it with London, and its appreciation by the people is shown by the great numbers of visitors, ranging from a few thousand to a hundred thousand people in a day, the latter crowd only on bank holidays or other special occasions.

The development of Kew Gardens from the first has been a struggle with adverse conditions. In the first place, the park is a flat meadow land bordering on the Thames, and all the slight inequalities of surface that now exist in the garden are artificial, having been made from ancient gravel pits or purposely excavated from the soil. There is little variation in the soil itself, which is generally of poor quality, underlaid by alluvial deposits of sand and gravel, which permit the rapid loss of water by infiltration. Not a rock occurs on the tract, and the rustic rock garden that is now one of the attractive features of the place was artificially constructed from the remains of an old stone building.

In all the features that pertain to natural location and diversity of structure our own Bronx Park possesses vastly superior advantages for a botanical garden by reason of its bogs, its meadows, its rocks, its wooded knolls, its meandering river, and withal a soil that will support its vegetation with far less care than must be constantly devoted at Kew. In fact, Kew lacks all those natural bits of rusticity that are constantly surprising one in our own garden and which the management has wisely determined to protect and perpetuate.

In the second place, the annual rainfall at Kew is less than at almost any other place in the British Isles—in fact, little above one-sixth of the maximum in the United Kingdom. This condition tends to drouth and necessitates a vast amount of artificial spraying; notwithstanding all this, the drouth of the past two summers made the beautiful lawns look brown and bleak, as though it were November instead of July.

Kew Gardens lie in an upward bend of the River Thames as it curves round from Twickenham Ferry to Mortlake, so that the outline is more or less irregular, though the eastern side is nearly straight, being bounded by the narrow road from Kew Bridge to Richmond. All along this road the gardens are shut in by the characteristic ugly brick wall, much like those that shut out the pub-

lic gaze from more than mere glimpses of the beautiful flower gardens of England and render the abrupt brick fronts of the houses more ugly than ever to one accustomed to anything better in the direction of more tasteful architecture. Here, however, the wall is higher than usual, but, fortunately, lacks the usual European *garçon-de-frieze* of broken bottles and window glass. The southern boundary is adjacent to the pleasure ground and deer park of Richmond.

Recently part of the grounds adjacent to Kew Palace have been sufficiently opened up, so that the palace is clearly seen from the Gardens. This old palace, unpretentious and ugly as it is, has its memories in fact and fancy, and its site has an older history still. Here stood the 'dairie house' which in Elizabethan times was owned by Robert Dudley, and here is where Leicester brought his first wife, the unfortunate Amy Robsart, after his marriage at Richmond Palace. Here, in the present palace, was the home of the good Queen Caroline, and here brave Jeanie Deans was brought into her presence by the noble Argyle to intercede for her unfortunate sister. Here the good queen died in 1737, and here George the Third, still wondering why he lost his colonies, passed his last mournful years in comparative solitude. At the rear of the palace, easily visible from the Thames bank and path, is the venerable linden tree, with its dense foliage, under which the children of George the Third were trained in their rustic out-of-door school, and a little farther up the Thames, on what is called 'Queen Elizabeth's Lawn,' is the old stump of the elm planted by the bloody Mary, still managing to put forth a few leafy branches, though merely a fragment remains of its former greatness. A much younger and smaller elm on the same lawn has a girth of nearly twenty-five feet.

Throughout the grounds at Kew are magnificent examples of many native and exotic trees; among the many are the noble oriental sycamore just beyond the old orangery; the weird cedars of Lebanon, near the pagoda; and, what are the most interesting, the black locust and the persimmon standing near the Temple of the Sun, the last particularly a much finer specimen than is usually seen in its American haunts. This group contains, perhaps, the oldest trees in the garden, and a tradition asserts that they were among the number transplanted from the garden of the famous Duke of Argyle. Besides these trees, which are not indigenous to Britain, are the groves of English beeches and elms in places surrounded by soil that has not been disturbed for over two hundred years and producing a spring flora unlike that of any portion of England for miles around. Here and there are magnificent couples of lindens or European oaks, often planted on a slightly raised artificial mound, and at one point there is a lonely row of decrepit elms carefully protected in their old age and known as the 'seven sisters'—tradition telling us that they were planted for the seven daughters of King George; only five of them now remain and some of these are badly battered by time.

Across the Thames from the garden, over a wide stretch of greensward toward which one of the delightful vistas of the garden opens, is the old Syon house, an old monastery and nunnery founded by Henry the Fifth in 1415, but closed for the second time by Elizabeth, and presented by her to the Duke of Northumberland, to whose line it still belongs.* A little farther up,

* This old monastery, like many others, has its quaint history, which has been elaborated in book form. One of its peculiarities, due, perhaps, to the fact that it was occupied by both monks and nuns, was the maintenance of silence, which necessitated the formation of a sign language as elaborate as it was peculiar. From its long series of signs we quote one or two samples:

in the old bit of wild woods in the vicinity, is a quaint old thatched cottage of the sixteenth century, which Elizabeth used to visit with her courtiers and which is still carefully preserved as 'the queen's cottage.' It is not surprising to those who are familiar with the inner history of these times that the lane leading to this cottage and formerly separating Kew Gardens from the Richmond deer park bore the name of 'love lane.'

Among the notable features of Kew Gardens that can be well recommended are the long vistas in the arboretum crossing each other at angles and serving to open up distant features of the garden grounds and thus preventing the massing of the vast crowds of visitors, who would otherwise endanger the glass houses and the tender ornamental plants of the more easily accessible portions. In the construction of these vistas the director has happily adopted the practice of trimming up the lower branches of the lines of trees, thus giving a more perfect appearance of distance and proper perspective to the vista. In the purely decorative portions of the grounds, which, by the way, are somewhat excessive for the scientific harmony of the gardens, there are masses of one sort of flowers in large beds, usually of a conspicuous color, which serve an impressive decorative purpose. The usual monotony of the level ground is varied here and there by shallow sunken areas with light terraces, including ornamental beds. The various buildings, conservatories and museums are widely separated from each other, as a further means of scattering the crowds of people who visit them. The two largest conservatories, the palm house and the temperate house, are over a quarter of a mile apart, and the three museum buildings are at the apices of a triangle whose sides measure 800, 1,100 and 1,500 feet respectively.

The famous flower paintings of the 'North Gallery,' representing the work of the busy but happy life of Marianne North, form a valuable and beautiful adjunct to the collection, as they represent the plants of nearly every flora of the earth exquisitely painted in their native and natural setting, and withal scientifically accurate in their delineation.

The waste steam from the engine house has recently been utilized to warm a small pond in which sub-tropical aquatics appear to be thriving at a latitude where they would otherwise fail to grow in the open, or, at least, fail to produce their blossoms. It surprises one familiar with English climate to see certain species of palms growing out of doors, and the bamboo plantation is one of the instructive features of the garden collection.

Among these praiseworthy features there are others that might be improved upon, and these should be noted. Besides the excess of area where a strictly decorative treatment obtains, there is a stiffness about certain portions, notably the herbaceous ground with its formal rectangular beds and the ugly brick wall that separates it from the rest of the garden. Strikingly in contrast with this, and more striking because of its immediate vicinity, is the rock garden which, though artificial, is really one of the most delightful bits of irregularity in the entire tract. It must in justice be said that some portions of the formality at Kew are inheritances from a royal past. Some of the old conditions seem strange to one of democratic birth; for instance, since a previous visit to Kew, in 1894, the wire fence that used to separate the more recent arboretum from the garden proper has been removed; on one

"Etyng. Pvt thy right thombe with two forefyngers joynd to thy mouthe."

"Fysshe. Wagge thy hande displaied sidelynges in manere of a fissh tail."

side of this fence smoking was formerly prohibited, while it was permitted, if not encouraged, on the other side; with the disappearance of the fence has died out the prohibition, for old customs do die even in conservative England.

Another feature lacking at Kew and emphasized by its presence at other places, notably, the gardens at Berlin, is the sharp definition of distinctive floras illustrating the modern principles of ecology. Nowhere could the contrasts of two strange floras be more strikingly shown than in the smaller greenhouse known as the 'succulent house;' here are two peculiar floras magnificently represented, the cactus flora of the Sonoran region of southwest America and the characteristic Euphorbiaceous flora of southern Africa. The geographic contrast of plants closely similar in habit but widely separated in their botanical characters might be most beautifully and forcibly illustrated here, but the opportunity is entirely lost, for the plants are commingled instead of contrasted and only the insignificant labels give to the expert the clue to this marvellous principle of plant distribution, while to the ordinary observer a most effective object lesson is entirely lost. Perhaps it may justly be said that with all their success at colonization, the principles of plant distribution are not so thoroughly grasped at Kew as they have been brought out at the German botanical garden through the skill of Professor Engler and his associates.

The museums, too, at Kew are greatly crowded and one leaves them with confused notions of their significance. This arises: first, from the fact that the buildings are small and two of them are badly broken up into a number of small rooms, and thus are not at all adapted to their present use; secondly, from the enormous mass of material crowded into insufficient space; thirdly, from combining the economic series that attempts to show the legion of plant products useful to man, with the taxonomic series that attempts to show the structural relations of plants to each other; and, finally, from the absence of any modern biological principle governing the arrangement of the collection. Even in the third museum, where the species of woods are illustrated, the collections, because of these features we have noticed, are vastly inferior to the magnificent Jesup collection in the American Museum of Natural History, where the value of rational methods of displaying a collection are added to the intrinsic value of the collection itself. At Kew the arrangement detracts from a collection which is the inferior of our own.

Having thus located Kew Gardens geographically and historically and noted some of its internal features, let us consider some of the results that are accomplished through its agency that we may arrive more happily at the *raison d'être* of the existence of botanical gardens in general.

1. The Kew Gardens represent the best expression of horticultural work in Great Britain. Many of the most noted gardeners in the Dominion, at home and abroad, are men who have been trained at Kew, and a succession of young men and women are continually being trained for this work from year to year. The advantages of such a garden training are evident to young gardeners, and there is always a larger waiting list of applicants than the work required can possibly supply. Kew is recognized as the authoritative center for horticultural work, and, interested as she is in introducing new forms from exotic sources, cannot fail to exert a marked influence on horticulture. Many plants find their way hither for authentic naming, and through the agency of Kew many plants of value for decorative purposes are brought to notice, not only in the British Isles, but throughout the world-wide British colonies.

So large a number of plants are continuously in cultivation at Kew that plant growers from all over the United Kingdom visit Kew for purposes of comparison of plants and methods, so that the Kew authorities are in touch with every plant grower of importance throughout the Queen's dominions.

2. A large and properly named collection of growing plants cannot fail to exert a positive educational influence on the general public. There is an amazing ignorance among all classes regarding the names and relations of trees and shrubs. We know the common animals, even those we see only rarely, but we pass under beautiful trees day after day, many of us, all our lives without recognizing either their names or relations, or noting their marked and positive characters; we know the common birds even, better than the trees in which they build their nests. A large and diversified named collection of trees and shrubs is, therefore, an educational influence of no small value. And this is more especially true when the plants are selected not merely because they present a mass of brilliant color, nor when they are selected for their mere novelty, as in the case of many private collections of note, but when, as at Kew, they are selected from all parts of the world to represent the distinctive vegetation of different regions, and from the entire range of the vegetable kingdom, and are arranged so as to show geographic (ecologic) and biologic relationships, and most especially when they are supplemented by museums illustrating the economic value of plants and their relation to man and his welfare. As we have said before, Kew is particularly hampered from her lack of suitable buildings for her museums. The three buildings occupied for this purpose were none of them originally intended for any such use. One was the orangery erected for the Princess Augusta in 1761, and bearing her monogram, and the other two were residence houses not in the least adapted to their present use as museums. This has necessitated the combination of the systematic (or more properly taxonomic) and the economic series, and has prevented as consecutive and logical an arrangement as would best serve educational ends. The New York Botanical Garden is fortunate in being able to outline its plans untrammeled by existing conditions other than those imposed by nature, and in arranging liberally for its museum under a single roof in a fireproof building, where its economic and taxonomic series of collections can be displayed, without crowding, on separate floors of the building.

3. The interrelations of Kew with the colonial gardens so widely scattered in both hemispheres and in every zone make possible the broad study of suitable economic plants for cultivation in a particular colony, and, reciprocally, the colonial stations are helpful in enabling the mother garden to know the conditions that exist which will permit the development of certain agricultural industries within their territory. In selecting plants of economic importance for new colonies or in aiding in the renewal of old colonies that have been ruined by neglect; in distinguishing between the varieties of cultivated plants more or less valuable for their useful products; in assisting to prevent the extermination of useful plants that are endangered in their native countries; in assisting to make more productive the enormous colonial development, and in preventing the destruction of forests that if continued would turn fertile provinces into desert places—in all these important factors of English civilization the Kew Gardens serve an important and useful purpose in advice and direction. The development of the cotton and cinchona culture in India, the agricultural development of Ceylon and the extension of the

area of cultivation of tea are all examples that illustrate the direct benefit of Kew to the English colonial system. And this influence is bound to extend still further. Many of the problems have been settled for the Asiatic colonies, and the Australasian region has begun to develop its own botanical centers; but the vast areas just opening up in the Dark Continent and the problems that will arise in regard to its agricultural development are yet to be worked out. The Anglo-Saxon is the only race that can enter a country, hold it firmly and elevate it in the scale of civilization by making it more productive. France has to face the difficulty of keeping up her own home population, and her colonial development has been comparatively feeble; the Spanish have nearly blighted every country on which they have laid their hand; and recent German attempts seem to merit for them the title of an impracticable people; the Anglo-Saxon blood, English or American, is destined to be the leading colonizing and civilizing spirit throughout the world in the future, as it has been in the past.

4. Aside from the economic features of the garden influence, there are others affecting the development of botany as a pure science that may well be considered. Connected with the garden is the largest herbarium of the world. Here are the types* of all the plants published at Kew from the British colonies; many others that have encircled the globe in every direction and have touched on every mainland and insular coast; others still that have been obtained through the purchase or donation of collections of other than British botanists. Besides these there are authentic if not type specimens derived from miscellaneous sources, in many cases vouched for by the author of the species himself and distributed with his own label.

In this way types or authenticated specimens of probably three-fifths or more of the 135,000 known flowering plants and ferns are here represented, and usually a great number of specimens represent the variations and geographic distribution of all except the rare species. More or less authentic specimens exist of most of the remaining two-fifths of the higher plants, so that the Kew herbarium is the consulting herbarium of every country, and its visitors' list for a year will disclose the names of botanists throughout the world. While at Kew during one summer I met botanists from Berlin, St. Petersburg, Brussels, Geneva, Java, Ireland, Trinidad, the Channel Islands, Arizona and Minnesota, all consulting either the growing collection in the garden or the specimens preserved in the herbarium. The other great European collections, notably the ones at Berlin and Paris,* are important and contain many types and must often be consulted for supplementing the types missing at Kew. The same may be said of other less important European collections, ranging from St. Petersburg to Madrid. The Torrey herbarium at Colum-

* By a type is meant botanically the original specimen from which the species was described when it was first made known. This specimen has a particular value, for if any subsequent question arises regarding the species in question it must be settled by reference to this type. Not unfrequently in the case of plants described from imperfect material the type is a much less complete representative of the plant than specimens collected later, but any question of appeal must be to the type itself.

* It was the writer's opportunity, after spending a summer at Kew, to visit, for a short time, the collection at the Jardin des Plantes. In this way the vastness of the Kew collection, as compared with that at Paris, was more forcibly impressed. At Kew the floras of even the French colonies themselves, collected by Frenchmen themselves, were abundantly represented. At Paris the collection was conspicuous by their absence. Even the series of plants representing the labors of French monographers are vastly better represented at Kew than at Paris. The Berlin collection, owing largely to the efforts of Dr. Engler, is much more important, and, in some directions, is rapidly gaining on its British rival.

bia, the Gray herbarium at Harvard and the National herbarium at Washington are any of them far richer in the representation of the plants of the United States; yet, considered from the standpoint of the world's flora, the collection at Kew is practically equal to all others combined in general completeness and diversity of representation.

The herbarium was formerly housed in another of the royal residences at Kew which adjoins Kew Green, and was called the house of the King of Hanover, because it was once occupied as the residence of that prince who succeeded to the throne of Hanover as George the Fifth.

This house for a long period was the sole repository of the great collections and library of the Kew Garden, but within the past few years the present director has expended a small appropriation in erecting a large three-galleried addition, which now contains all the plants above the ferns, but which is very inconvenient because of the lack of concentration on a single floor and the necessary waste of time in passing from books to specimens and *vice versa*. It is the greatest cause for regret among those who appreciate its value to science that the building is not fire-proof. It is a sad comment on the scientific public spirit of England that her government should permit this invaluable collection to remain in any other than a fire-proof building. The loss of this enormous collection would be irreparable, and would alike affect the botanical knowledge of all the great floras of the globe, from Canada to Tasmania and from Iceland to the Straits of Magellan, wherever British colonial activity and scientific exploration have manifested themselves. To leave such a collection in even the remotest peril from destruction by fire is a national disgrace that the good sense of the English government ought to correct without delay.

The Kew herbarium has for years been under the care of J. G. Baker, well known for his publications on ferns and monocotyledons. Recently he has been succeeded by his able assistant, W. B. Hemsley. George Massee, author of a work on British fungi, is in charge of the lower cryptogams. Besides these the strictly botanical staff consists of six botanists and botanical assistants, a botanical artist, besides some clerical force. The morphological and physiological work is carried on for the Garden under Dr. D. H. Scott, at the Jodrell Laboratory, within the garden enclosure. Besides the regular staff there are other familiar faces at Kew, who may be classed as voluntary workers. These include, besides the former Director, Sir J. D. Hooker, Professor Oliver, the associate and assistant of Bentham; C. B. Clarke, well known for his publications on the botany of India; M. C. Cooke, and others more or less regular.

The publications of Kew have been enormous. The bibliographical list published in 1895 includes over 1,600 titles, varying all the way from a discussion of some useful plant to the flora of a continent, and from an octavo pamphlet to a ponderous folio volume. In 1863 Sir William Hooker projected a series of 'Floras' on a uniform plan in the English language for all the English colonies. This project has been carried on steadily to the present time. Of these the 'Flora Australiensis,' by Bentham, 1863–1878, in seven volumes, and the 'Flora of British India,' by Sir J. D. Hooker, 1875–1894, are the most important that have been completed. At present the force is actively engaged on the 'Flora of Tropical Africa,' probably the most difficult undertaking of all. It is an unfortunate circumstance that while the Germans are actively engaged on a similar work there is simply rivalry instead of cooperation in its elucidation. The colonial rivalry seen in Central Africa at this time between the Germans and the English, as manifested

by rival steamship companies and rival railroads to Lake Nyanza, is likely to be beneficial in opening up to civilization more rapidly larger areas of territory than could otherwise be reached ; but in the scientific publication of the flora of the region rivalry is likely to result in greater harm than good, for a considerable portion of the work of two independent sets of workers is likely to be duplicated. In the matter of building railroads the British are likely to outstrip their rivals, but in the careful and thoughtful working-out of the great problems presented by the flora the more philosophic German is almost sure to make the better showing. The collection at Kew is so extensive that English botanists have too often neglected the opportunity to compare types at other herbaria easily within their reach and have sometimes belittled work that has been accomplished elsewhere ; such self-importance always suffers a decline, and in this the Kew botanists might have learned a lesson from the history of American botany in the last quarter of a century. But there is hope for better things, for one of the Kew botanists during the summer of 1897 made a visit to Berlin to compare the types in that herbarium, the first Kew botanist that has visited the Berlin collection since Bentham's time, thirty years ago. It is to be hoped that this visit will result in opening the eyes of English botanists to the facts recognized everywhere else, that more careful and philosophical floristic work is being accomplished at Berlin even with more scanty materials in the collection. Kew, too, is learning how to introduce into her staff men of university training more familiar with modern ideas of botanical study.

Besides the floras above noted, the most important work issued from Kew is *Genera Plantarum*, by Bentham and Hooker, which for the first time brought together compact Latin descriptions of all the genera of flowering plants. It was commenced in 1862 and was completed in 1883, only a short time before the death of its veteran author. This work has not only made possible the study of distant floras of the earth and stimulated the botanical exploration of unknown regions, but has laid the foundations on which the more recent as well as the more logical and complete arrangement has been developed under the editorship of Professor Engler, at Berlin, *Die natürlichen Pflanzenfamilien*.

As a supplement to the *Genera Plantarum*, the botanical world is further indebted to Kew for the *Index Kewensis* in four massive quarto volumes, with the names all the flowering plants that had been described up to 1885, with citation of place and date of publication and geographic distribution. This enormous piece of bibliographic work, involving hundreds of thousands of references, was accomplished under B. Dayton Jackson, Secretary of the Linnæan Society, who spent ten years in its completion, the expense being met by funds left for the purpose by Charles Darwin.

Such is Kew with its beautiful lawns, its delightful shade, its historic associations, its immense collection of cultivated plants, and its wonderful activity in the direction of botanical research. Botanical gardens in America can never have the historic associations of their English rivals, but in this country they will be free from most of the conservative inheritances with which the older gardens are hampered. While they can never possess the ancient types of the early explorers, they can and do possess the equally valuable modern types of more recently discovered species, and their collections will in time become just as representative and more complete for the American flora at least than the one at Kew. Besides their philanthropic and educational value, which is chiefly confined to the immediate vicinity in which they are located,

their general usefulness must be world-wide. Their field of investigation even is not to be confined by the artificial limits of the United States, though much remains to be known of our own flora, even that of the more carefully explored eastern region, and especially among the hordes of lower plants that are just beginning to be disclosed. The whole American continent, from Alaska to Cape Horn, with all that immense dark continent of South America, must be the working field of the American botanist. The investigators of the Old World are naturally more concentrated on the study of their own continent, and are generally agreed to leave America to the Americans. The Spanish Americans have accomplished almost nothing in the development of the knowledge of their own floras or the possibilities of their economic vegetal products. The Anglo-Saxon blood in the New World, as in the Old, must originate and direct all exploration and development, and this will form one portion of the work of American botanical gardens. But the scientific study of the flora is only the foundation, the very necessary first step for subsequent work. The study of the active properties of plants, medicinal or otherwise useful to man, deserves close attention, as the recent discovery of numerous important economic products will testify. The question of extending the already prodigious work of transporting the more abundant products of the tropical zone to the region of the highest civilization forms another problem in which the botanical expert is needed to cooperate; then there are important problems of ecology, of plant physiology and of plant diseases, all of which have a direct bearing on the constant and ever-increasing supply of food and shelter for the human race, and these can only be worked out in the presence of such conditions and such extensive collections of plants as a large botanical garden will afford. An extensive garden, with a director at its head who is primarily a botanist with the widest possible acquaintance with plants and who understands in in what directions botanical science needs to be developed so as to prove most beneficial to the race at large, and with departments of research so endowed that skilled botanical experts in their exclusive specialties can prosecute their investigations free from galling questions of personal support —such a garden is capable of becoming even more influential in democratic America than Kew has become throughout the length and breadth of the Queen's dominions.

LUCIEN MARCUS UNDERWOOD.

ABSORPTION IN VERTEBRATE INTESTINAL CELLS.

THE lining membrane of the vertebrate intestine consists of a single layer of cells. These cells are of two kinds. Designating them according to their form, the accepted nomenclature is Cylinder cells and Goblet cells. Certain authors have, however, adopted a nomenclature based on physiological differences and term them Protoplasm cells and Mucus cells.

The Cylinder or Protoplasm cells are typical epithelial elements. They have the form of five- or six-sided pyramids, the broad end facing the lumen of the intestine and the narrower end resting upon connective tissue (Tunica propria). Oppel (Lehrbuch der Vergl. Mikr. Anat.) calls the attached end the base and the free end the apex. The apex is characterized by the possession of a striated border, a structure having the appearance of a bunch of cilia. Its true nature is still in doubt. The nucleus is relatively large and situated near the basal end. The cells have no membrane. They are usually several times as numerous as the goblet cells.

The Goblet or Mucus cells have typically a goblet shape, but show great variation in this respect. They are usually described as

consisting of two parts: the Foot, attached to the Tunica propria, narrow, protoplasmic and containing the nucleus; and the Theca, opening into the lumen of the intestine, broad and filled with a secretion termed mucus. The protoplasm of the goblet cells is much denser in texture than that of the cylinder cells, and their nuclei stain more intensely. Two of these cells never occur in juxtaposition, cylinder cells being always interposed.

Closely associated with these two elements, although having only a topographical relation with them, are Leucocytes or wandering cells. These occur in various positions within the mucus membrane, either between or beneath the epithelium cells. In the former position they usually lie in a line with the nuclear row; rather less frequently nearer the lumen of the intestine. In the latter position they are scattered throughout the connective tissue stroma, and may, in the higher vertebrates, form dense aggregations, termed nodules. A nodule consists of a connective tissue frame-work, inclosed by a delicate membrane, the whole closely packed with leucocytes. The nodules may occur singly or in groups, in which latter case they constitute follicles. Peyer's patches are a familiar example of these structures. Their actual position is within the mucosa, but they encroach, on one side, upon the submucosa, and, on the other, may break through the mucus membrane and project into the cavity of the intestine.

The three elements above described make up, in its entirety, the lining of the vertebrate intestine, and it is through them and by their means that food, after being acted upon by digestive fluids, is absorbed and eventually distributed throughout the various parts of the body. Three phases may then be distinguished in digestion: First, the sifting-out of the useful constituents of the food from the useless and the reduction of the former to a condition in which they may pass through the intestinal mucus membrane. Concerning these processes a considerable fund of accurate information has been collected. There is much difference in detail in different groups of animals; but in general, nitrogenous bodies are transformed into peptone, carbohydrates into mono-saccharides, while fats are apparently broken up into a soap and glycerine. The change in the nitrogenous bodies is brought about by pepsin and trypsin. Carbohydrates are acted upon by ptyalin and amylopsin. Concerning fats the customary statement is that they are first emulsified by bile and then analyzed by steapsin. It is noteworthy that the pancreas furnishes enzymes capable of digesting all classes of food. The above doctrine is that generally accepted, and, beyond any doubt, it is entirely correct so far as it goes. But there are reasons for believing that the cylinder cells of the intestine are also of great importance in the furnishing of digestive fluids. Howell (American Text-book of Physiology, 1896), speaking of 'succus entericus,' says: "Upon proteids and fat it is said to have no specific action. * * * Upon carbohydrates the secretion has an important action." Foster (A Text-book of Physiology, Philadelphia, 1895) also mentions the succus entericus, but ascribes very little importance to it. On the other hand, Landois (Lehrbuch der Physiologie des Menschen, 9 aufl., 1896) summarizes the action of intestinal juice (Darmsaft) as follows:

1. Diastatic action.
2. Metamorphosis of maltose into glucose.
3. Conversion of fibrin, fresh casein, raw and cooked meat and plant albumin into peptone.
4. Analysis of fat.
5. Metamorphosis of di- into mono-saccharides.
6. Coagulation of milk.

Thus there are dissenting opinions amongst physiologists, but in this connection it is to be remembered that it is practically impossible to obtain normal intestinal juice. The method consists in cutting out a portion of the intestine and attaching this by both ends to a fistula made in the body wall. In this way admixture with gastric or pancreatic juice is prevented, but the conditions are highly abnormal and negative results with fluid obtained in such a way are of little weight. Moreover, physiologists usually make their experiments on mammals, whereas a study of the lower groups gives support to the view that intestinal cells can secrete ferments having the same properties as those of the stomach and pancreas. Thus, the Cyprinoid fishes lack a stomach and extracts of their intestines can digest fibrin. The alimentary canal of the Cyclostomes is a straight tube, entirely wanting in diverticula. It is, therefore, probably safe to conclude that the view expressed by Landois is essentially correct, although it is not to be understood by this that the succus entericus has anything like so powerful an action as the enzymes from stomach or pancreas. Its properties are the same in kind as these, but much feebler in degree.

The third class of foods consists of fats. These, unlike proteids and sugars, are apparently insoluble in the various digestive fluids. It seems, however, that steapsin is able to saponify fat. That this process actually takes place has been proven by chemical analysis made on the contents of the intestine of animals fed on fat. For this reason, and for others to be given below, it is generally supposed that fat enters the intestinal epithelium as soap and glycerine. The evidence is, however, somewhat contradictory, and this question can hardly be considered absolutely settled.

The second phase of the digestive process, absorption, consists of the passage of the prepared food through the epithelium of the intestine; in reality, its entrance into the body, for hitherto it has been outside. This food, as has been seen, is in solution, and the older physiologists considered its entrance to be either a mere soaking through or else an osmatic process. But it has been shown that this view is erroneous. Without discussing what the actual process may be in intravitam staining, it is known that living protoplasm behaves differently with different stains. Living spermatozoa can be stained differentially, while protozoa will take up certain anilines and wholly resist the action of others. That is, protoplasm has the power of resisting the entrance of certain substances. This power is clearly demonstrated by the epithelium of the intestine. The laws of diffusibility do not hold true. For example, if a solution containing equal parts of sodium sulphate and glucose be allowed to act on the living intestinal mucus membrane, the glucose will be almost entirely absorbed and the sodium sulphate scarcely at all. Yet the salt is much more diffusible than the carbohydrate. The epithelial cells, then, possess a selective power which is obviously dependent upon the activity of their protoplasm. That this is of great importance to the organism needs no emphasizing.

The entrance of proteids and sugars has not been studied cytologically. Such an investigation, although of the utmost importance, presents extreme difficulties. The preliminary process essential to mounting would probably take out of the cells all such substances, and the work would necessarily have to be done on fresh cells. But proteid reactions are obscure and indefinite, and this, along with the technical difficulties in the way, a magnification of 750–1,000 diameters being necessary, has evidently discouraged such researches, and our actual knowledge on this point is nil. Having entered, however, it has been satisfactorily

demonstrated that proteids and carbohydrates are taken up by the blood and that they do not enter the lymphatic system.

Natural fats are mixtures of the three chemical compounds—Olein, Palmatin and Stearin. Of these, the first is a liquid, the other two are solids. Consequently, the proportions in which these three ingredients are mixed conditions the melting point of the fat. Tallow and lard are high in stearin, while cod-liver oil is high in olein. Thus the melting point of fat enables us to form an idea as to what animal produced it. But all fats, of whatever nature, reduce osmic acid, producing an intense black coloration, and this clear and distinctive test furnishes the reason why the absorption of fat has been a favorite study with cell-physiologists. In passing a piece of intestine tissue through the various processes necessary for its microscopical study all nitrogenous bodies in solution in the cells are very probably dissolved out by the alcohols, but fat is only very slightly soluble in alcohol and not particularly so in cedar oil, and accordingly preparations that still contain a large part of their original fat contents may be studied. The error is more likely to be in the other direction; osmic acid is reduced by all organic matter, and it is extremely probable that many cell aggregates, not fat at all, have, by virtue of their having actually reduced osmic acid, been mistaken for fat.

Taking up now in detail what has been learned concerning the absorption of fat, we find that there are three conflicting theories. These are:

1. Fat enters between the epithelial cells.
2. Fat enters the epithelial cells.
3. Fat enters both ways.

Concerning the first of these views, that the only entrance path of fat is between the cells, it has had, in so far as I have been able to learn, but one advocate (Watney, 1877), and the appearances are so strongly against it that we are probably entirely safe in rejecting it in toto.

With regard to the other views the matter at issue is much more comprehensive than the mere entrance of fat. One of these, the second, holds that the sodium salt of a fatty acid (a soap) and glycerine enter the cell in solution. The reasons for believing this are, first, the general reason that the solids have never been known to enter the intestinal epithelium, and, second, the appearances in the fixed cell. The striated border and a narrow band running across the cell just beneath the striated border are always free of fat.* It first appears lower down in the cell and arises as exceedingly minute globules, which roll together and fuse and eventually come to form masses, which may be so large that two or three fill the entire cell. That is, the soap and glycerine are synthesized, and fat appears in an exceedingly minute state of division. The increase in size of these particles is a merely mechanical phenomenon and has been observed in living cells. At the expiration of a certain period after the commencement of absorption a second process is inaugurated. This has been studied the most carefully in those forms which possess intestinal villi, and the following is applicable to only such. A very fine canal system has been described by some, consisting of vessels that extend from the base of the cell into the lacteal, but more accurate observation has shown that such does not exist. The fat merely passes from the cell, the determining factor in its movement being protoplasmic activity, and becomes scattered throughout the stroma of the villus, lying in a peri-cellular fluid which occupies the spaces between the connective tissue cells and fibers. Heidenhain (1888) has given a very clear expla-

* This has been disputed. Some writers have described fat both in and just beneath the striated border.

nation of the method by which it enters the lacteal. The villus is enclosed externally by the epithelial layer, and its center is occupied by the lacteal. In the space outside of the lacteal and inside of the epithelium there is the connective tissue (in which the fat is scattered) and muscle fibers. These muscle fibers lay along the length of the villus. They are attached to the connective tissue at the base of the villus and inserted in the inside of the epithelial row and in the walls of the lacteal. Now, when the muscle contracts it will pull upon the connective tissue fibers that bind it to the lacteal and to the epithelium, and these, in their turn, pull the epithelium inwards and the wall of the lacteal outwards. The force is the same in both cases, but the epithelium is far more resistant than the wall of the lacteal, and the result is that the volume of the vessel is increased. This causes a negative pressure within the lacteal (valves prevent its filling up from the large lymphatic vessels) and a positive pressure in the stroma between it and the epithelium, and in consequence the peri-cellular fluid, with its fat, is forced to enter it. From the lacteal it, of course, enters the lymphatic system and eventually the blood.

The other theory gives to the leucocytes the primary rôle in the absorption of fat. This holds, in general, that fat, and other food as well, is taken from or from between the cylinder cells by leucocytes and by them carried into the circulatory system. The details are held to be as follows: The eating of a meal brings about great activities on the part of the leucocytes. The number of them in the intestinal walls increases manyfold. This increase is brought about in two ways. There is active cell-division on the part of those leucocytes present in the nodules and scattered throughout the mucosa, and, in addition, there is a migration from other parts of the body. The facts upon which this belief is based are the great increase in size of the nodules during absorption and the presence of innumerable mitoses in the cells themselves. One observer (Schäfer) describes the process for the frog as follows: Beneath the epithelial row the leucocytes divide, the new cell consisting of a nucleus with a minute quantity of protoplasm. It moves either close up to or between the epithelial cells and ingests food. During this process it increases enormously in size and eventually carries the load of food back into the connective tissue, where it enters a lymph capillary. That it is food which the leucocyte carries back, seems to be proved by fat feeding, following which the returning leucocytes contain granules that give the osmic-acid test.

These two theories are contradictory, but not mutually exclusive, for it is conceivable that both processes may take place side by side. Leucocytes are known to ingest foreign substances while in the blood, and, although there are reasons for supposing that this phenomenon is of the utmost benefit to the organism as a whole, it is not supposable that leucocytes have been evolved for the particular function of disposing of pathogenic bacteria. Similarly, in the intestine, the proximity or actual contact of foreign substances in the form of fat globules would undoubtedly provoke activities on the part of the leucocytes. They would ingest such particles freely, but rather for their own individual benefit than for that of the organism as a whole. This would, of course, be of benefit to the organism as a whole, since the return of the leucocytes to the lymphatic system and their death there would increase the amount of food in the lymph, but this conception differs very materially from that which holds that leucocytes function as fat carriers and that without them fat could not enter the lymph. There is, moreover, direct evidence which bears on

this point. Heidenhain has observed that in suckling mammals, which must necessarily be absorbing fat, there are very few leucocytes present in the intestinal mucus membrane. He also throws doubt on the fatty nature of the granules observed returning leucocytes that respond to the osmic-acid test, observing, with considerable point, "Nicht alles ist Fett, was in Osmium säure dunkelt." It is thus possible to bring such observations as these of Schäfer's quoted above into line with the views advanced by Heidenhain. Leucocytes may, as described, divide, migrate out near the surface of the mucus membrane, take up food and convey it back into the lacteal, but the rest of the organism is not dependent upon them.

The third phase of digestion is that which takes place in the cells, and consists in building-up of food substance into protoplasm. This process is of chemical nature and consequently wholly beyond the reach of direct observation. The advances that are being made in the province of organic chemistry lead to the hope that the albumen formula may eventually be discovered, and were this done the synthesis of protoplasm would be at least a theoretical possibility. At present, however, our knowledge of the actual conditions that exist in living matter is so slight that even speculation is useless.

Howard Crawley.

University of Pennsylvania.

SCIENTIFIC BOOKS.

Zoological Results based on Material from New Britain, New Guinea, Loyalty Islands and Elsewhere, collected during the years 1895, 1896 and 1897. By Arthur Willey. Cambridge, Eng., the University Press. 4to. Part I., 1898; pp viii+120; pls. 11. Part II., 1899; pp. 85; pls. 12.

The zoological materials collected by Dr. Arthur Willey during his search for the Pearly Nautilus have been distributed to specialists and will form the basis for a series of five or six published parts, the first two of which have already appeared. These of themselves are a substantial acknowledgment to the Board of Managers of the Balfour Studentship and to the Government Grant Committee of the Royal Society, by whose generosity Dr. Willey was enabled to prosecute his researches.

Part I. opens with an account, by Dr. Willey himself, of the anatomy and development of a new species of *Peripatus* from New Britain. The species hitherto described, as Sedgwick has shown, fall into three natural groups, corresponding to their geographical distribution: Neotropical, Australasian and Ethiopean. For each of these Pocock has proposed new generic names. Dr. Willey's new species represents a fourth geographical group, which may be called the Melanesian, and for which he proposes the generic or subgeneric name of *Paraperipatus*, the species being *P. novæ—britanniæ*. As Dr. Willey justly remarks, it is not to be expected that a new species of *Peripatus* would throw much light on the vexed question: Is *Peripatus* an annelid or an arthropod? What is probably needed is something between *Peripatus* and other forms rather than more *Peripatus*.

The Phasmidæ, or walking sticks, have been reported by Dr. D. Sharp. Upwards of twenty species were collected, of which fourteen seem new to science. The report contains an extended account of the eggs and pre-adult stages of these insects.

The scorpions, pedipalpi and spiders were represented by forty-nine species, of which sixteen are stated by Pocock to be species novæ. The descriptions of these include a number of interesting biological notes. The cocooning habits of *Fecenia* and *Ordgarius* are described, and a species of *Conothele* which has subvertical mandibles is shown for the first time to build its nest on trees in the same way as other trapdoor spiders that have this structural peculiarity. In a new species of *Plexippus* the mandibles and maxillæ form a stridulating organ.

Besides this report, Pocock has also contributed an account of the centipedes and millipedes, of which there were twenty-one species, thirteen new to science.

The first part also contains the description of

a new species of Caprellidæ, *Metaprotella sandalensis*, by Dr. P. Mayer, and notes on a little known sea-snake by G. A. Boulenger.

Part II. contains a description of the coral-like *Millepores* by S. J. Hickson. All the specimens are referred to one species, *M. alcicornis*. Material for the study of the soft parts of these delicate organisms was collected. Some of this was found to be infected by what seemed to be a species of *Bacterium*, and which Hickson has named *B. milleporæ*. The nettling capsules were studied in detail, and in some the 'thread' had the form of a delicate tube, in the center of which was a filament. This is probably contractile and brings about the remarkable retraction of the 'threads,' as observed by Dr. Willey in the living animal.

Of the crinoids, sea urchins, star fishes and brittle stars thirty-nine species are reported by F. Jeffrey Bell, almost all of which were well-known forms. Of the twenty-four species of sea-cucumbers collected, F. P. Bedford reported two new to science.

None of the twenty-three species of Sipunculids obtained were new, a fact accounted for by Shipley from the circumstance that the two largest collections of these worms ever made, namely, those of Semper and of Sluiter, were made in the same general region as that in which Dr. Willey worked. While such an outcome may be disappointing to those who are ambitious for the description of new species, it is reassuring in that it shows that a piece of zoological work once well done need not be repeated.

Fourteen species of solitary corals are recorded by J. S. Gardiner, and of these no less than eleven are new. Gardiner also contributes a paper on the post-embryonic development of one of these, *Cycloseris*, in which the close affinity of this genus with *Fungia* is emphasized. Of the thirteen species of fleshy corals of the family gorgonaceæ reported by I. L. Hiles five are new.

The earthworms were studied by F. E. Beddard. Some were too immature for certain identification, but among the well-developed specimens nine species were recognized, three of which were new.

The second part is fully equal to the first and is especially noteworthy for the success with which photography has been used in its illustrations. The photogravure plate accompanying Gardiner's paper on *Cycloseris* is remarkable for the sharpness of its detail; the naturalness of the figures exceeds that found in the best hand lithography. The photographic prints which illustrate Hickson's paper on the *Millepores* give an idea of the nature of the material collected, which in the case of these extremely variable animals could be obtained by no other method. The authors and publishers alike are to be congratulated on their successful use of photography.

So far as the present work is concerned, such criticism as may be offered touches rather the whole undertaking than any particular part thus far completed. While it may be gratifying to an explorer to see the results of his collecting and personal investigation in the form of a compact whole, it is not always certain that this is the best way in which to make it accessible. Such publications are dependent largely on subscription for their circulation and necessarily fall much behind the better class of scientific journals. Since, as in the present case, they contain the first descriptions of many new species, their relative inaccessibility is often a serious obstacle to succeeding investigators. It is to be regretted that all the present series of contributions could not have found places in some of the current zoological journals, as, in fact, some have, thus, in a measure, assuring the accessibility of their contents.

G. H. P.

Traité élémentaire de mécanique chimique, fondée sur la thermodynamique. By P. DUHEM. Vol. III.; 18x25 cm.; pp. 374. Vol. IV.; 18x25 cm.; pp. 381. Paris, A. Hermann. 1898 and 1899.

Vol. III. treats of homogeneous mixtures and solutions with only one volatile component. The opening chapter deals with the thermodynamic potential of a homogeneous mixture. This is followed by one on the state of dissolved substances and by another on dilute solutions. Next in order comes osmotic pressure, and then we find chapters on the hypotheses of Van't Hoff and of Arrhenius, and on the mass law.

The second half of this volume is given up to a discussion of equilibrium in systems containing one solution phase and at least one solid phase.

Volume IV. is devoted to what Duhem calls 'double mixtures' and to general equilibrium in heterogeneous systems. By 'double mixtures' Duhem means two component systems containing at least two phases of variable composition. Under this head come fractional distillation, critical states of mixtures, liquefaction of mixed gases and systems containing two liquid phases. A great deal of space is devoted to a consideration of the alleged law that the vapor-pressure of a dineric system is the same as that of the more volatile component. The volume closes with a general discussion of the phase rule, in the course of which it is pointed out that the classification followed throughout the four volumes has been based on the phase rule and that all good classifications must be so based. This is very satisfactory, but it would have been more satisfactory if we had been told this at the beginning of the first volume instead of at the end of the fourth. One great fault in all of Duhem's writings is his refusal to tell the reader what is to be proved. The result is that the reasons for the single steps do not become clear until the second reading. From the Baconian point of view it is very pretty to marshal the facts in a splendid array and then to point out the general law of which they are special illustrations, but Bacon is not famous as a successful writer of text-books. It would have been very much simpler to have deduced the phase rule and then to have pointed out the way in which it should be applied. As far as the qualitative equilibria are concerned, this is also the historical method. Gibbs deduced the phase rule as a general theorem, and Roozeboom has, since then, shown its value as a guide.

These four volumes of Duhem's constitute a monumental work and will be of immense service. On the other hand, it would easily be possible to overestimate their value. What we have is an exhaustive study of chemical equilibrium put into mathematical form and expressed in terms of the thermodynamic potential. This application of mathematics to chemistry is unfortunately more ornamental than useful. There are myriads of formulas, but very few can be applied to any concrete case. The book is really only a mathematical outline in which formulas are indicated. The equations contain unknown functions. To the experimental theorist the book is a joy and a sorrow, a joy because it points out so much and a sorrow because it always stops short of becoming practical. One of the most striking features about Helmholtz was the fact that he cast his theoretical speculations into such a form that they could be tested quantitatively. Duhem has never done this in physical chemistry. He has done brilliant work, but his theory has always been qualitative and not quantitative theory. If anyone doubts this he has only to read the four volumes of the *Mécanique chimique* and he will be convinced.

Wilder D. Bancroft.

Le céramique ancienne et moderne. Par E. Guignet et Edouard Garnier. Paris, Felix Alcan, 108 Boulevard Saint-Germain. 1899. 8vo. 69 figs. Pp. 311.

This volume is No. 90 of the series 'Bibliothéque Scientifique Internationale,' edited by M. Em. Alglave. Its authorship is in collaboration by MM. E. Guignet and Edouard Garnier. The work consists of two grand divisions, the first, by the Director of the Dyeing and Coloring Department of the Gobelin and Beauvais Tapestry Manufactories, relates to the fabrication of ceramics; the second, by the Conservateur of the Museum of the Pottery and Porcelain Manufactories at Sevres, is on the history of Ceramics.

The first part deals with the material of which pottery and porcelain is made, describes it at length, shows the differences between the different products, gives by analysis the component parts of the various materials required for these products, and describes their mode of treatment and preparation for use. It presents by elaborate definitions the different kinds of ceramics, and shows principally by chapters, the differences between pottery, faience and porcelain. It represents by description and diagram the machinery used in the treatment of the material, in the fabrication and forming of the objects, and the ovens in which they are baked.

This part of the work is interesting and valuable, showing, as it does in detail, the different kinds of ceramics and wherein that difference consists, a branch of the art which has been neglected by amateurs generally and for whose enlightenment this part of the work will be specially valuable.

The second part deals with the history of ceramics. Its primary divisions are by the different kinds of pottery: mat, varnished, enamelled, fine, and ends with porcelain. Within the purview of each of these chapters, geographic subdivisions are made and the ceramics of the respective countries described. The processes of manufacture are not touched upon in the second part.

THOMAS WILSON.

A Short History of Freethought, Ancient and Modern. By JOHN M. ROBERTSON. London, Swan Sonnenschein & Co., Ltd.; New York, The Macmillan Co. 1899. Pp. xv + 447.

Those who know Mr. Robertson mainly for that perfervid, not to say intemperate, though able book, 'Buckle and his Critics,' will likely enough be swift to shun this new work. Its title and Mr. Robertson's previous performance certainly give ground for summary suppositions as to to the contents of the 'Short History.' It ought, therefore, to be said at once that our author contrives to keep his balance here, for the most part, and has produced a book which is well worth reading and studyimg. Of course, like the majority of self styled 'freethinkers,' he is not nearly so fundamental as he supposes, and still occupies a standpoint which, though fashionable and influential more than a century ago, does little to further 'freethought' to-day, and much to discredit it. Nevertheless, he does attempt to maintain a scientific attitude, and, on the whole, he does not allow preconceptions to run away with him completely. This at least is somethiug to be thankful for. His careful citations, too, are much to be commended, even although he often contrives to cite as authorities some curiously lop-sided performances.

The book covers an enormous range. This is due to the definition of 'freethought' proposed in the introduction and faithfully upheld throughout. "For practical purpose, then, 'freethought' may be defined as a conscious reaction against some phase or phases of conventional or traditional doctrine in religion—on the one hand, a claim to think freely, in the sense not of disregard for logic, but of special loyalty to it, on problems to which the past course of things has given a great intellectual and practical importance; on the other hand, the actual practice of such thinking (5)."

Following out this definition, the work consists of sixteen chapters; these deal with primitive 'freethinking,' with 'freethought' in the ancient religions, in Israel, in Greece and Rome, in early Christianity, in Islam, in the Middle Ages, the Renaissance and the Reformation. Thence the author passes to modern 'freethought'; deals with the English deistic movement, Cartesianism, and the conditions preceding the French Revolution; takes a peep at the United States, and then, in a long chapter, the most interesting of all, discusses the 'culture forces' of the nineteenth century. The conclusion is a brief, and inadequate (in the sense of being sadly out of perspective), review of the present state of thought in the nations. Considering the range covered, and the extent to which secondary authorities are necessarily relied upon, the author's management of his material is deserving of the highest praise. It would be a good thing were the average 'orthodox' to peruse the book carefully—nay, to have it beside them. It might open their eyes to not a little which, as matters now stand, they seem never to fathom.

Naturally, in so extended a study Mr. Robertson has his lapses, and it is interesting to note that these accumulate precisely in the period which he knows best—the modern. Bias here plays its unavoidable part. Of Voltaire we are told that his 'sheer influence on the general intelligence of the world has never been equalled by any one man's writing' (338). On p. 344 we are informed that Rousseau, 'though not an anti-Christian propagandist, is distinctly on the side of Deism'; on p. 354, when another purpose is on hand, we are surprised to learn that he was 'devoutly theistic.' The 'Critique of Pure Reason' is said to be 'definitely anti-religious' (388), a statement sufficiently extra-

ordinary, but outdone a little later, when we learn that the modern movement 'back to Kant' was one of religious compromise! On the other hand, Mr. Robertson has some excellent things. His view of the English deistic movement, as against Mr. Leslie Stephen, is thoroughly sound; similarly his summary of the defects of 'higher criticism' (407) is full of point; while here and there we meet with illuminating remarks, such as that it is 'the tendency of every warlike period to develop emotional rather than reflective life' (409); and that 'the abstention of later specialists from all direct application of their knowledge to religious and ethical issues is simply the condition of their economic existence as members of university staffs' (408). As one looks around upon professorial philosophy, is not this all too true?

Taking the author at his own word, and remembering the limits distinctly laid down in the preface, the book is an excellent one, and it ought to find its way into many hands. It will startle the smug obscurantist, and will afford the free man—who is much more common than Mr. Robertson thinks—many cues to follow up in further reflection. If the author would put his eighteenth century rationalism behind his back, he might produce a definitive history, not of free thought—for all *thinking* is free by the nature of the case—but of man's gradual rise to a more fully reasonable explanation of himself and his environment.

R. M. Wenley.

University of Michigan.

SCIENTIFIC JOURNALS AND ARTICLES.

The *American Journal of Science* for July contains the following articles:

Velocity of Electric Waves in Air; by G. V. Maclean.

Spiral Fulgurite from Wisconsin; by W. H. Hobbs.

Chemical Composition of Parasite and a new occurrence of it in Ravalli Co., Montana; by S. L. Penfield and C. H. Warren.

Estimation of Iron in the Ferric State by Reduction with Sodium Thiosulphate and Titration with Iodine; by J. T. Norton, Jr.

Mouth of Grand River; by E. H. Mudge.

Electrical Measurements; by H. A. Rowland and T. D. Penniman.

Reflection of Hertzian Waves at the Ends of Parallel Wires; by Lee DeForest.

In a thesis entitled 'An Experimental Study of the Corrosion of Iron under various Conditions' accepted for the degree of Bachelor of Science in Electrical Engineering, in the University of Wisconsin, Mr. Carl Hambuechen shows that whether an iron surface which has been subjected to corrosive influences has a uniform corrosion, local pittings or corrosion along definite lines or curves is dependent upon the physical and chemical character of the iron. The conclusion is drawn that a study of such corroded surfaces, which may be produced quickly by electrolytic means, may give considerable insight into the properties of iron. The main part of the thesis deals with an investigation of the energy expended when iron is subjected to strain, part of the energy being expended in heating the iron, but the greater part being stored in the metal and manifesting itself in an increased tendency to corrosion and a higher electromotive force of contact between the iron and an electrolyte. Measurement of this increase of electromotive force while the iron was subjected to increasing stresses showed that a curve giving relation between stress and electromotive force is obtainable; this curve being similar to the stress-strain diagram, and each curve showing clearly the point of elastic limit. The fact that a metal under stress has a greater chemical activity will afford an explanation of many peculiar cases of corrosion, such, for example, as the peculiar appearance of hardened steel which has been subjected to electrolytic corrosion.

In an article on Russian Museums, Mr. F. A. Bather thus discusses the question as to whether or not museums should send out collections for study: "The occasional loss of a specimen is nothing as compared with the increased value of a properly worked-out collection. If a museum is unable for any reason to send out collections to specialists, then it must have a large and properly paid staff. It is the business of a museum to encourage culture and to be a headquarters of intellectual activity in its various departments. A slight experience serves to show that the museums which prosper

are those which enter into the most cordial relations with a large body of students."

IN the June number of the *Journal* of the Boston Society of Medical Sciences Dr. James H. Wright has a paper on the application of color screens to photomicography, in which he shows that by a proper use of filtering light media the clearness and accuracy of photomicrographs may be greatly enhanced.

SOCIETIES AND ACADEMIES.

GEOLOGICAL CONFERENCE AND STUDENTS' CLUB OF HARVARD UNIVERSITY.

Students' Geological Club, May 2, 1899.—Mr. A. W. Grabau gave a *résumé* of the paleontology of the Boston basin.

Geological Conference, May 9, 1889.—Under the title 'Tertiary Granitic Intrusives of the Yellowstone Park,' Dr. T. A. Jaggaer, Jr., reviewed Mr. Arnold Hague's paper on 'The Tertiary Volcanoes of the Absaroka Range' (SCIENCE, IX., pp. 425–442).

Students' Geological Club, May 16, 1899.—At a special meeting of the Club, Mr. L. LaForge exhibited his collection of Chemung fossils.

Geological Conference, May 23, 1899.—Three papers were presented at this final meeting of the year. Mr. A. W. Grabau discussed 'Some Modern Stratigraphic Problems' from a paleontological point of view. He emphasized the importance in paleontological work of the division of marine organisms into Plankton, Nekton, Benthos, Meroplankton and Pseudoplankton, and held that extensive deposits of planktonic organisms enclosed by beds of shallow water origin indicate a period when the land stood at baselevel. Benthonic animals are important as facies fossils, and the benthonic mode of living exerts a great influence in the development of local faunas. Repopulation of a district by a benthonic fauna which has occupied it at an earlier date—through the medium of meroplanktonic larvæ, as demonstrated by Walther—was illustrated by examples drawn from the Hamilton of western New York. Graptolites and Ammonoids, as pseudoplanktonic organisms, are important as index fossils.

Among local or provincial faunas acceleration was considered to be one of the foremost means of differentiating species. Thus, the Fusidæ of the Paris basin appear to have developed independently from those of the Hampshire basin of England. In each area a complete, distinct, phylogenetic series has been discovered. These, although parallel, present specific differences throughout; while certain individuals suggest occasional migrations of species from one basin to the other.

In considering the operation of barriers upon migration the case of the genus *Fulgur* was cited. This gastropod has inhabited the Atlantic coast between Cape Cod and the Gulf of Mexico since Miocene time, its northward and southward migration being prevented by climatic causes, due largely to topographic conditions. That their young are not carried to other similarly characterized shores appears to be due to the fact that the veliger stage is passed in the egg capsule, so that in this gastropod the planktonic larva does not exist.

Mr. H. T. Burr gave 'Results of Recent Studies of the Geology of the Boston Basin,' and Mr. L. LaForge spoke on 'The Relation of Dikes, Joints and Faults in Somerville, Mass.'

J. M. BOUTWELL,
Recording Secretary.

DISCUSSION AND CORRESPONDENCE.

BODY BLIGHT OF PEAR TREES.

IN the spring of 1898 when preliminary studies with* apple canker were begun at this station a few inoculations were made in the limbs of a large pear tree with cultures of *Sphæropsis*, taken from cankered apple limbs. The fungus grew readily at all points of inoculation and produced dead sunken areas of the outer bark, similar to those that are so common on the trunks and larger limbs of pear trees. These definitely outlined and sunken areas of dead bark, commonly known as body blight, have long been thought to be due to the action of the pear blight bacillus. However, it may be pointed out that body blight is preëminently a disease of the outer bark, while with pear blight the reverse is true since the cambium layer is first attacked.

*SCIENCE, Vol. VIII., pp. 595 and 836.

The full significance of the result of these inoculations was not realized at the time since it was not then known that *Sphæropsis* occurred on these blighted areas. In the spring of the present year, however, a *Sphæropsis* was found to be comparatively abundant on the diseased bark of pear trees in the station orchards. Since that time a large number of pear trees from various localities affected with body blight have been examined and in nearly every instance this fungus was found to be more or less abundant. One case particularly worthy of notice was that of a comparatively young orchard that was severely attacked by body blight and the fruit of a *Sphæropsis* was so abundant that the conclusion was irresistable that this fungus must be the cause of the disease.

Numerous inoculations made this spring with cultures of the *Sphæropsis* in large trees and in nursery stock clearly show that this fungus may produce body blight of pear trees.

Other species of fungi closely associated with the *Sphæropsis* frequently occur on trees attacked by body blight, *Macrophoma malorum* (Berk.) Berl. et Vogl. being specially abundant. The studies have not yet progressed far enough to determine what part these other fungi play in producing the diseased condition. Bacteria may also be concerned in this trouble, but of this we have as yet no proof.

W. Paddock.

Geneva, N. Y.

Formation of Cumulus Clouds over a Fire.

In Science of January 8, 1897, Mr. R. DeC. Ward describes the formation of cumulus clouds over a fire in Cambridge. Last Friday (June 30th) another phenomenon of this kind was observed at Blue Hill and from Winthrop and approximate measurements of the height obtained.

The fire was in South Boston and consumed the buildings of the Bay State Iron Works. The smoke cloud was not of unusual size, but rose vertically to a considerable height (800 to 1,000 metres), encountering at this height a northwesterly wind, which swept it nearly horizontally over the harbor. The fire began before 8 p. m., and the smoke reached its greatest height about 8:05 p. m. At 8:03 p. m. a small white cloud began to form at the apex of the smoke, which at this time was apparently nearly over Long Island, in Boston Harbor. The cloud increased rapidly in height, assuming the form of a true cumulus and reaching its greatest size at 8:05 p. m. The accompanying sketch shows roughly the appearance of the smoke and the cumulus at that time. The sky

CUMULUS FORMING OVER FIRE, JUNE 30, 1899.

was nearly clear, no other low clouds being in the vicinity of the smoke. The cumulus cloud is shown at (A) and apparently was about 3° in height and length, the highest or thickest end being toward the north. Between 8:05 and 8:07 p. m. another smaller cloud formed at the edge of a rift in the smoke considerably lower than the one just described. Its position is shown at (B). Mr. A. E. Sweetland, of this observatory, who at this time was in Winthrop, about 5 miles (8 kilometres) northeast of the fire, estimated the altitude of the highest cumulus to be 15°, while a measurement made with the nephoscope at Blue Hill, about 10 miles (16 kilometres) south of the fire, gave 10° as its altitude as seen from the observatory. These measurements show that the vertical height of the top of the cloud at A was at least 2,500 metres, while that of the cloud at B was about 2,000 metres, above sea level.

The smoke began to diminish in quantity at 8:07 p. m. and separated from the clouds, which became flatter and more elongated. At 8:11 the clouds were separated from the smoke by a space several degrees wide, and after this time they slowly evaporated.

S. P. Fergusson.

Blue Hill Observatory, July 1, 1899.

A Reply to Mr. Marlatt's Article on Sources of Error in Recent Work on Coccidæ.*

When I lived in Colorado, some years ago, I remember hearing it said that a man who had

*Science, June 16, 1899, pp. 835–837.

been there six months knew all about the weather, but one who had been there six years never knew anything about it. A similar paradox is common in biological science; and hence it results that Mr. Marlatt, who has only recently begun the study of Coccidæ in detail, is much more sure about the nature of their specific characters than the present writer, who has been occupied with these insects for eight years. If there is one thing which the detailed study of species teaches, it is that *no man can prophesy beforehand what characters are going to prove specific and what variable.* When the material available is scanty it is largely a matter of guess work to pick out the specific characters, and the majority of new species proposed must be regarded in a sense as provisional. Indeed, the conditions for the absolute proof of the validity of a species are rarely fulfilled, since it has to be demonstrated that nowhere in its whole range does the alleged species intergrade with any other. Let the ornithologist of the Middle States, familiar with the yellow-shafted *Colaptes*, go to the Far West and find there the red-shafted species, *C. cafer*. In either locality he may examine thousands of birds, yet the differences are quite constant; the species are indubitably 'good.' But now let him go to eastern Wyoming, and he finds the two inextricably mixed up, and concludes that there is only one *Colaptes* from the Atlantic to the Pacific.

The general statements made by Mr. Marlatt are most of them applicable to the majority of Coccidæ, and so far are neither new to nor unheeded by the authors of the work he criticises. But there are exceptions, more numerous, probably, than most of us imagine. Take the often quoted case of the Jamaican *Aspidiotus aurantii*, which attacks palms and lignum vitæ, but never *Citrus*. This creature is indistinguishable, so far as known, from the pest of the orange tree found in California and elsewhere. Mr. Marlatt cannot fail to see that a distinction of this sort, however troublesome to the systematist, is both of scientific and economic importance. But this form of *A. aurantii* has not yet been proposed as a species, in the ordinary sense of the word, nor has it even any name. Some *varietal* names have been proposed by Maskell and King for a few Diaspinæ which burrowed under the epidermis of plants, and this fact is thus distorted by Mr. Marlatt: "Several *species*, or *subspecies*, of scale insects have been established on accidental variations of this character, as, for example, *Chionaspis furfurus*, var. *fulvus*, King. Examples of the types of this *species*, * * * etc." It really looks as if the writer of the paragraph considered variety, subspecies and species to be synonymous terms!

What has really happened is this: In the course of years past, one after another, new forms of *Aspidiotus* came to the hands of students of Coccidæ. These were examined and, when apparently distinct from others, were described and named, sometimes as species, sometimes as varieties. Some little time ago Mr. Marlatt proposed to make a critical study of *Aspidiotus*, based on the valuable collections of the Department of Agriculture and such other material as could be obtained. Those who had described new species mostly sent their types or co-types, and thus Mr. Marlatt had before him a much better series than any other student, few of the valid species being lacking. The present writer has had the pleasure of going over Mr. Marlatt's work, and gladly testifies that it is excellent and will, when completed, mark a great advance in our knowledge of the genera examined. As might be expected under the circumstances, Mr. Marlatt has detected various errors in the work of his predecessors, and in other cases believes, but cannot prove, that their conclusions are wrong. Several species are to be reduced to varieties or synonyms; some varieties are to be raised to species. For all of this let us be sincerely thankful, but it is not an occasion for running *amuck*. The present writer never sat down to any lengthy piece of work without finding many things to be changed in his own former results and those of others. It is quite useless to hope to avoid error, but by continuous study we may gradually approach nearer and nearer to truth. That is all I ever hope to do or expect of others.

"The writer trusts that the foregoing criticisms will be taken in the kindest spirit, as they are intended, and he does not wish it

to be thought," etc., etc. (cf. Marlatt, l.c., p. 837).

T. D. A. Cockerell.

N. M. Agricultural College.

POT-HOLE VS. REMOLINO.

To the Editor of Science: In your issue of July 14th you publish a communication from Mr. Oscar H. Hershey, in which he advocates the substitution of the Spanish word 'remolino' for the term 'pot-hole,' as applied to rounded cavities formed by rivers in their rock-beds.

The term pot-hole may not be elegant, but it certainly expresses the object to which it is applied more correctly than would the Spanish word he seeks to adopt in its place. The definition of 'remolino' is a whirlpool, or whirlwind; it is also applied to a turbulent or disorderly mob of people.

While a whirlpool may be the cause of a 'pot-hole,' it would be improper to substitute the cause for the effect.

The fact that the word *remolino* is not properly applied in the Republic of Colombia, perhaps only coloquially, is no justification for the introduction of an incorrect term into American scientific nomenclature.

F. F. Hilder.

Washington, D. C., July 15, 1899.

NOTES ON INORGANIC CHEMISTRY.

The pupils and former colleagues of Professor Joly, of the École Normale of Paris, are continuing with good results the researches of Joly on platinum groups of metals. Brizard, of the École Normale, has continued the study of the osmiamates begun by Joly. These compounds were discovered by Fritzsche and Struve half a century ago, being formed by the action of ammonia and caustic potash on osmium tetroxid. The formula assigned was $K_2Os_2N_2O_5$. Joly was led to suspect that the compound contained the NO group, analogous to his nitroso compounds of ruthenium, and partial analyses and its decomposition products pointed in the same direction. Brizard has now confirmed this by complete analyses of the potassium, ammonium and silver salts, and the formula proposed by Joly $KOsNO_3$ is proven correct. The osmiamates are thus salts of the anhydrid of a nitroso acid $OsNO(OH)_3$, which corresponds to a hydroxid of ruthenium $RuNO(OH)_3$ discovered by Joly.

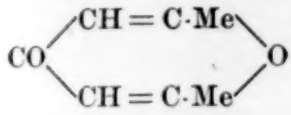
In the same number of the *Bulletin Soc. Chim.* is a paper by Professor Vèzes, of Bordeaux, continuing his work on the oxalates of the platinum metals. This paper takes up the oxalates of palladium. These may be formed directly by the action of potassium oxalate on potassium chlorpalladite in neutral solution, or by the action of oxalic acid on potassium palladonitrite. Unlike the case with platinum, the same salt is obtained in both cases, a potassium palladooxalate of formula $Pd(\overline{Ox})_2K_2 3H_2O$. This salt is easily converted back into the chlorpalladite by hydrochloric acid, and into the palladonitrite by potassium nitrite in neutral solution. Professor Loiseleur, of Libourne, has succeeded in preparing the free pallado-oxalic acid. It thus appears, as with platinum, a very close relation subsists between K_2PdCl_4, $K_2Pd(NO_2)_4$ and $K_2Pd\overline{Ox}_2$, and also that the pallado-oxalates are not double salts merely, but 'complex' salts and derivatives of a 'complex' pallado-oxalic acid.

Professor Vèzes has also contributed to the *Zeitschrift für anorganische Chemie* a short note on the volatilization of osmium in a stream of oxygen. The paper was occasioned by an article by Sulč on the same subject, showing that osmium is volatile at ordinary temperatures. Vèzes calls attention to the fact that Deville and Debray had long ago noticed this fact, which was further studied by Joly and himself. The volatility of osmium depends not only on the fineness of its division, but also upon the method of its preparation, some forms being volatilized appreciably at quite low temperatures.

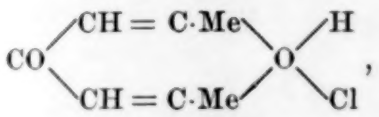
The so-called 'metallic' variety of phosphorus is shown by D. L. Chapman, in the *Proceedings of the Chemical Society* (London) to be identical with red phosphorus, their appearance under the microscope being similar. The alleged higher vapor tension of some varieties of red phosphorus is merely due to impurity. The vapors from red and from ordinary phosphorus are identical, and at the temperatures of boiling mercury and of boiling sulfur show a

density which corresponds to a molecule containing four atoms at the fusing point of potassium iodid; red phosphorus under pressure is converted into ordinary phosphorus.

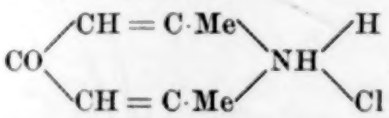
THE *Proceedings* for June 1st contain the abstract of a paper by J. N. Collie and T. Tickle, which, while dealing with an organic substance, has a direct bearing on the valence of oxygen. Dimethyl pyrone acts as a base in forming a large series of salts by the direct addition of acids without elimination of water. The chloroplatinite is also formed. From this the inference is drawn that the oxygen is the base-forming element and that its valence in the salts must be four. The formula of the base is



and of the salts



, corresponding in every way to the salts of dimethyl pyridone, as



. As there seems to be in the compound no other element which can be base-forming, it would seem that oxygen must be added to the list of base-forming elements, nitrogen, phosphorus, sulfur and iodin, and that we now have oxonium bases.

FLUORIN has been given as present in analyses of some mineral waters, as those of Mont Dore and of St. Honoré les-Bains. F. Parmentier has made a careful examination of these waters, and his results, published in the *Comptes Rendus*, show that no fluorin is present. The etched appearance of glass vessels in which these waters have stood is shown to be due to the deposition of silica, of which a considerable quantity is present in the waters, and not to any real etching or the deposition of any fluorin compound.

J. L. H.

CURRENT NOTES ON METEOROLOGY.

FOEHM WINDS.

IN the *Meteorologische Zeitschrift* for May, Billwiller gives a clear and concise account of the various kinds of winds which he believes should be classed together as *foehm winds* (*Ueber verschiedene Entstehungsarten und Erscheinungsformen des Föhms*). There are five varieties in all. The first is the best known of all, viz., the *foehm* on the northern slopes and in the northern valleys of the Alps, which occurs during the passage of an area of low pressure across central and northern Germany. It is this warm, dry wind which is so important a factor in the climate of some of the Swiss villages, Meiringen, for instance. Its rapid evaporation of the deep winter snows has gained for it the name of *shneefresser*. The north *foehm* on the southern side of the Alps is the second class, which occurs when barometric minima move across the northern Mediterranean region and thus draw down the air from the mountains, or when a barometric maximum is forming or approaching on the northern side of the Alps, thus producing a considerable gradient to the south. A simultaneous appearance of *foehm* winds may take place in both northern and southern Alpine valleys when there is a well-marked descent of the air over the mountains. This gives rise to the third class of these winds. Under the influence of the Alpine topography the slow down-settling of the air within an anticyclone may become locally hastened, and thus there results a development of air currents dynamically warmed, which constitute the fourth class of *foehm* winds. Lastly come the dry, *foehm*-like winds which have occasionally been noted as blowing out of winter anticyclones in cases where there is no effect of topography. Although the immediate cause of the occurrence of these warm and dry winds may be different in different cases, this does not affect the nature of the *foehm* itself. A distinct division cannot well be made between the various classes and the term *foehm* should, therefore, be used to describe the characteristics of the winds, rather than their immediate cause.

LIGHTNING AND THE ELECTRICITY OF THE AIR.

UNDER the title, *Lightning and the Electricity of the Air*, A. G. McAdie and A. J. Henry, of the U. S. Weather Bureau, have prepared a report which has been issued as Bulletin No. 26, of the Weather Bureau. This Bulletin consists of two

parts, the first of which, by Mr. McAdie, deals with the electrification of the atmosphere and the measurement of the potential of the air—auroras and protection from lightning. Mr. McAdie has made himself an authority on lightning in this country, and whatever he has to write about lightning always finds large numbers of attentive readers. Most of Mr. McAdie's portion of this Bulletin has previously been printed. Part II., by Mr. A. J. Henry, deals with matters of very general interest, viz., loss of life and of property by lightning; character of soil as influencing lightning strokes; kind of trees struck by lightning, and the question, is the danger of lightning stroke increasing. The Bulletin is illustrated by means of a considerable number of views of lightning flashes and of damage done by lightning, and will doubtless prove interesting and profitable reading to a great many persons.

HEAVY RAINFALL IN THE CAMEROON MOUNTAINS.

THE extraordinary rainfall at the base of Cameroon Peak (13,369 ft.) is made the subject of a brief communication by Hann, in the May number of the *Meteorologische Zeitschrift*. The mean annual rainfall at Debundja (Lat. 4°8′ N.; Long. 9°0′ E. approximately), altitude 16 ft., as determined by three years' observations, is about 370 inches. This rainfall shows a double period, viz., a maximum in June and a second maximum in September. At Bibundi, 1 km. distant from the ocean and about 10 ft. above sea level, the rainfall in the year 1897 amounted to 412 inches. These rainfalls are only exceeded by the rainfall at Cherrapunji, on the Khasi Hills, in Assam, where the annual amount is 474 inches. Hann is of the opinion that when additional stations are established on the slopes of the Cameroon Mountains, they will show a rainfall equal to that of Cherrapunji.

VERTICAL TEMPERATURE GRADIENT USED ON WEATHER MAPS.

THE daily weather map for June 16, 1899, issued at San Francisco by A. G. McAdie, Forecast Official, notes the vertical temperature gradient in the atmosphere in the vicinity of San Francisco at the time of the morning observation. We believe that this is the first instance on record in which data concerning the vertical temperature gradient have been included on a daily weather map. The following is the reference as printed at the base of the map in question: "In the vicinity of San Francisco this morning the vertical gradient of temperature is about one degree increase for 80 ft., up to an elevation of 2,500 ft. The relative humidity at sea level is nearly 100 per cent.; at Mt. Tamalpais, 23 per cent.

RECENT PUBLICATION.

Weather Forecasting: Some Facts Historical, Practical and Theoretical. WILLIS L. MOORE, Chief of U. S. Weather Bureau, U. S. Department of Agriculture, Weather Bureau, Bulletin No. 25. 8vo. Washington, D. C., 1899. Pp. 16.

THE contents of this Bulletin are sufficiently described by its full title. The matter was first printed in the *Forum* for May, 1898.

R. DE C. WARD.

SIR WILLIAM FLOWER.

IN an obituary notice of Sir William Flower, whose death we were compelled to record last week, the London *Times* comments as follows on his contributions to museum administration:

The greater part of his active life was spent in the direction of important museums, and the question of their practical organization was one in which he always took a keen interest, and in which probably his best work was done. Both by precept and example he assiduously urged the importance of museums as instruments for the advancement of knowlege, and it cannot be doubted that his efforts did much to dispel the delusion—which even now lingers on in some quarters—that any miscellaneous collection of objects, huddled together in any sort of way, is all that is wanted to constitute a useful museum. In his presidential address to the British Association at Newcastle, in 1889, he treated the subject at length, and particularly emphasized the importance of properly selecting and arranging the specimens exhibited. A museum, he pointed out, can promote science in two ways—by affording facilities for scientific research and by providing opportunities for popu-

lar instruction—and if it is to be efficient its collections must be arranged with reference to the special function regarded as its primary end. It is absurd to set before the ordinary visitor a long series of specimens only differing in the most minute details, while it is equally absurd to ask a student engaged in writing a monograph on some obscure morphological point to be satisfied with a selection of typical forms such as the former would find infinitely more instructive. These views he had an opportunity of putting into practice during the time he was head of the Natural History Museum at South Kensington. The numerous alterations he there carried out in the arrangement and nomenclature of the specimens were attended with excellent results, and the adoption of improved principles of classification, together with the relegation to store-rooms of objects which, though of value for purposes of study, were superfluous in exhibition cases, had the effect of greatly increasing the interest of the museum as well as enhancing its educational usefulness.

During the time he was in charge of the Hunterian Museum Sir William did a great deal to supply the deficiency which existed in this country of materials for studying the physical characteristics of the different races of men, and under his care the collections of the College of Surgeons increased enormously, both in extent and usefulness. For instance, in 1884 they contained 89 more or less complete skeletons and 1,380 crania (not including the Davis collection purchased in 1880), whereas 20 years before they had only 18 skeletons and 242 skulls. To him must be ascribed much of the credit of the increased opportunities thus afforded for the study of the osteological variations of man, for it was largely owing to his alertness and watchfulness that the College seized every opportunity of acquiring specimens, thus in many cases saving them from the destruction and neglect which too often is the fate of small private collections. It need scarcely be added that the objects were arranged and looked after in the most approved manner, an instance of the time and labor he spent on them being afforded by the osteological catalogue he published with carefully verified measurements of no less than 1,300 human skulls.

SCIENTIFIC NOTES AND NEWS.

AT its recent decennial celebration Clark University conferred the degree of LL.D. on the foreign lecturers, Professors Boltzmann, Picard, Mosso, Ramon y Cajal and Forel.

THE Albert Medal of the Society of Arts has been awarded to Sir William Crookes, F.R.S., "for his extensive and laborious researches in chemistry and in physics, researches which have, in many instances, developed into useful and practical applications in the arts and manufactures."

PROFESSOR KARL VON ZITTEL has been elected President of the Munich Academy of Sciences in succession to Professor von Pettenkofer.

SIR GEORGE STOKES has been elected a foreign member of the Berlin Academy of Sciences.

WE learn from *Nature* that a civil list pension of 60*l.* per annum has been granted to Mrs. Kanthack "in consideration of the eminent services rendered to science by her late husband, Dr. A. A. Kanthack, professor of pathology in Cambridge University."

THE French Minister of the Interior has sent Dr. Vignes to Great Britain to report upon the ophthalmological methods of that country.

GLASGOW University has conferred the degree of LL.D. on Mr. R. L. Jack, Government Geologist of Queensland.

THE Adams Prize of the University of Cambridge has been awarded to Dr. J. Larmor and Mr. G. T. Walker.

DR. F. KLEIN, professor of mathematics at Göttingen, and Dr. W. Nernst, professor of chemistry at the same university, have been elected foreign members of the Academy of Sciences at Buda-Pesth.

MR. D. L. WILDER has been appointed Assistant on the Iowa Geological Survey.

MAJOR-GENERAL SIR JOHN F. D. DONNELLY, K.C.B., retired on July 3d from the secretaryship of the British Science and Art Department, after 40 years in the public service. In consequence of Sir J. Donnelly's retirement, the Duke of Devonshire, Lord President of the Council, has made the following appointments: Sir George W. Kekewich, K.C.B., the present Secretary of the Education Department, to be

also Secretary of the Science and Art Department; Captain W. de W. Abney, C. B., to be the Principal Assistant-Secretary of the Science and Art Department; Mr. W. Tucker, C.B., to to be the Principal Assistant-Secretary of the Education Department.

Dr. E. von Lommel, professor of physics in the University of Munich, died on June 19th, aged 62 years.

Mr. Richard Congreve, a well-known writer on Comte's philosophy and on social and political subjects, died in London on July 5th.

An International Conference of Horticulturists was opened last week in London. Among American delegates were Professor L. H. Bailey, of Cornell University, and Mr. T. G. Fairchild and Mr. H. J. Webber, of the Department of Agriculture.

Nature states that the prize of 500 guineas, offered by the Sulphate of Ammonia Committee for the best essay on 'the utility of sulphate of ammonia in agriculture,' has been awarded by the judges—Mr. J. Bowen-Jones, of Shrewsbury, and Dr. J. Augustus Voelcker, of London—to Mr. James Muir, County Instructor in Agriculture to the Somerset County Council. Seventy-three essays were sent in.

It is expected the Queensland Parliament will grant £1,000 towards the British Antarctic Expedition.

The estate of late Samuel J. Tilden has finally been settled. The report of the referees shows that the New York Public Library, composed of the Astor, Lennox and Tilden foundations, has received $2,859,000. This is about one-third the sum Mr. Tilden wished to devote to the foundation of a public library.

The Dismal Swamp, 143,000 acres in extent, partly in Virginia and partly in North Carolina, has been bought by lumber merchants who propose to drain it. This would greatly alter the fauna and flora of a region of much scientific interest.

The State Zoologist of Minnesota, Professor Henry F. Nachtrieb, has equipped a houseboat for the study of the fauna of the Minnesota and Mississippi Rivers, particularly the fishes. The houseboat was built at Mankato and started down the river about the middle of May. The party is in charge of Professor U. O. Cox, of Mankato Normal School, and expects to reach the southern border of the State by the first of September. The data and material thus far collected are very satisfactory and encouraging. It is the hope of those interested in the work that this may become the beginning of a permanent station. The party consists of Professor Cox, J. E. Guthrie, Chas. Zeleny, Wm. Kienholz, and occasionally also of Professor Nachtrieb.

The *Botanical Gazette* contains news in regard to botanical excursions as follows: Dr. Charles E. Bessey proposed to visit the foot hills of western Nebraska, collecting specimens and making phytogeographical notes in the region above 1,200 m. altitude. Professor John Macoun is engaged in field work upon Sable Island, 'The Graveyard of the Atlantic.' Later in the season he will examine botanically some of the remote parts of New Brunswick. Dr. J. N. Rose is making explorations in central and southern Mexico. He proposes to make a special study of the genus *Agave* and an investigation of the Tampico hemp industry.

Professor E. M. Shepard, of Drury College, and lately of the Missouri Geological Survey, has returned, says the *American Geologist*, from a trip to the Hawaiian Islands, New Zealand and Australia. He has secured numerous and fine photographs of active volcanoes, coral islands and glaciers.

The steamship *Diana* was expected to sail from Sydney, Cape Breton, yesterday. As we have already stated, it carries supplies to Lieutenant Peary, under the direction of Mr. Herbert L. Bridgeman, New York, and in addition takes three scientific parties: One under the direction of Dr. Robert Stein, which will remain in Ellesmere Land; one under Professor William Libbey, of Princeton University, equipped especially for deep-sea exploration, and one under Mr. Russell W. Porter, of Boston, in the first instance a hunting party.

On behalf of the British government Mr. Francis Mowatt has written to Lord Lister in regard to the National Antarctic Expedition as follows: I am directed by the Lords Commis-

sioners of her Majesty's Treasury to inform you that the First Lord has laid before the Board the memorial signed by your lordship as President of the Royal Society, by the President of the Royal Geographical Society and by other distinguished representatives of various branches of science, by which memorial application is made for a government grant in aid of the expedition now being organized by the Royal Society and the Royal Geographical Society for the exploration of the Antarctic regions. This application has received the careful consideration of her Majesty's government, and I am directed to inform you that they are prepared to ask Parliament for grants amounting, in all, to £45,000 towards the expense of the proposed expedition, provided you are able to assure them that no less than equal amounts will be forthcoming from other sources, so as to enable the scheme to be efficiently carried out. In making this announcement I am to call attention to the latter part of the speech of the First Lord to the deputation which waited on him on this subject, as indicating that her Majesty's government must not be regarded, in making this promise, as inaugurating a new era of more extensive grants than formerly from the Exchequer in aid of scientific enterprises. Rather, it is to be understood that the very exceptional importance of the present scheme, so strongly represented by the deputation, is being recognized by the promise of a special grant. At the present time it is only necessary to add that the applications to Parliament for instalments of the grant will be spread over four years, of which 1900–1901 will be the first.

ALTHOUGH the Paris municipality voted to dismiss M. Bertillon from the Anthropometric Bureau on account of his testimony in the Dreyfus case, the Prefect of Police maintains that this ought not to affect his position as a municipal officer, and it is understood that the resolution will not take effect.

THE anti-vivisection people are arranging an exhibit for the Paris exposition. From a booth documents will be distributed and petitions circulated. It has been proposed to exhibit instruments used in vivisection and models of animals under vivisection.

A DINNER was given by the Folk-lore Society of Great Britain on June 26th, in honor of Professor Frederick Starr, of the University of Chicago. The London *Times* states that Mr. E. S. Hartland, Chairman of the Society, presided, and among others present were Mr. Bryce, M.P., Mr. Andrew Lang, Miss Kingsley, Sir R. Temple, Professor Rhys Davids, Professor and Mrs. Haddon, Mr. Edward Clodd and Professor Ridgway. The toasts 'The Queen' and 'The President of the United States' having been honored, Mr. Lang proposed the health of the guest of the evening. Professor Starr, he said, had conducted several expeditions into the heart of Mexico. He congratulated the University of Chicago on its possession of a professor of anthropology. He confessed that the University of St. Andrews had never yet had a professor of anthropology and was not likely to have one, though Chicago was not founded, like St. Andrews, in the interests of culture. No saint ever dwelt there, so far as he knew, and its University was not the original center of the city. Chicago, had, however, 'taken hold of' culture, and one of the indications of its intention to do so thoroughly was its possession of Mr. Starr as a professor of anthropology. He concluded by proposing the toast with Highland honors, which were duly accorded, amid considerable laughter at the complete incongruity of the preceedings. The chairman announced that the committee of the Folk-lore Society had unanimously elected Professor Starr as honorary member of the Society, and had resolved to ask his acceptance of a set of the Society's publications. Professor Starr responded, expressing his high appreciation of the honor that had been accorded him. Mr. Clodd proposed 'Our Kindred Societies,' Professor Haddon replying for the Royal Society and Mr. C. H. Read for the Society of Antiquaries and the Anthropological Institute. 'The Folk-lore Society' was proposed by Sir Richard Temple; the Chairman, Mr. Alfred Nutt, responding. During the evening Mrs. Kate Lee, Hon. Secretary of the Folk-song Society, sang some folk-songs which she had recently collected.

THE second of the receptions held annually by the Royal Society took place on June 21st.

The exhibits were, to a large extent, the same as those which were shown at the May *soirée*, and which we have already mentioned. Of additional exhibits the *Times* notes a series of Japanese paintings exhibited by Mr. W. Gowland which were an interesting novelty, showing as they do the different modes of depicting animal and plant life practiced by some of the great masters of the art of painting in Japan. So, too, were Sir Martin Conway's views in the Bolivian Andes, which were also exhibited during the evening on the screen by means of the lantern. Dr. Francisco Moreno showed a superb series of photographs and photographic panoramas illustrative of scenery in Patagonia. The models of the *Turbinia*, of a torpedo-boat destroyer and an Atlantic liner of 38,000 i. h. p. were of special interest. For more reasons than one Mrs. Ayrton's experiments on the hissing of the electric arc attracted considerable attention. Quite a novelty was Professor Haddon's collection of polished stone implements from the Baram district, Sarawak, Borneo. This is the first fruit, so far as public exhibition goes, of the important expedition to Torres Straits and Borneo, from which Professor Haddon has just returned. The Milne horizontal-pendulum seismograph, with specimens of the seismograms yielded by it, exhibited by the Seismological Committee of the British Association, was also new. It is a specimen of the earthquake records which are now being kept at a considerable number of stations established at widely-separated localities. In addition to the Andean views of Sir Martin Conway, Dr. Tempest Anderson exhibited, in the lecture-room, by means of the lantern, some very striking views of Vesuvius in eruption, and Mr. Herbert Jackson showed experiments displaying some new phenomena of phosphorescence.

In the House of Commons Sir S. Montague recently called the attention of the President of the Board of Trade to a paragraph in the sixth report of Mr. T. Worthington on British trade in South America to the following effect: That the metric system is the only one recognized; that an English foot-rule cannot be legally imported, and that the trade of Great Britain suffers greatly by not adopting compulsorily the metric system used by almost all the the civilized nations of the world. He also referred to the Consular report on the trade of Amsterdam issued last month to the effect that, unless Great Britain adopted the metric system of weights and measures, it might look on the Continental and perhaps on other markets as lost to it; and asked whether Mr. Ritchie would facilitate the adoption of the metrical system in Great Britain by using metrical weights and measures in the government departments. Mr. Ritchie replied that there is now no reason why any manufacturer or trader in Great Britain may not carry on his foreign trade in terms of metric weights and measures. He stated that he was in communication with some government departments on the concluding paragraph of the question.

The Volta centenary exhibiton at Como, to which we have already called attention, includes some interesting relics of Volta. These are contained, according to Mr. G. H. Bryan, (*Nature*) in one room in the exhibition buildings set apart for the 'Cimelii di Volta,' under which head are comprised Volta's physical apparatus, original manuscripts of his papers, his letters, diplomas and many of his personal effects. The greater part of these relics are exhibited by the Reale Istituto Lombardo, under whose auspices the collection was formed by public subscription in the years 1861 to 1864; for this collection one of the rooms belonging to the Society at Milan has been specially set apart. Other relics, chiefly personal, are exhibited by Professor Alessandro Volta and Professor Zanino Volta. The University of Pavia exhibits several electroscopes, condensers and similar electrostatic apparatus; and other exhibits are lent by the Como Museum. The manuscripts include the following: (1) A letter to Volta from the French physicist Nollet, dated September 18, 1767; (2) A letter from Volta to Professor Barletti, of Pavia, dated April 18, 1879, containing an anticipation of the electric telegraph. Volta suggests the possibility of connecting Milan and Como with a wire suspended from poles, so that an operator at one end of the line could fire an electric pistol at the other. (3) A manuscript dated May 14, 1782, dealing with animal electricity.

(4) Volta's paper of March 29, 1800, announcing his discovery of the electric pile to Sir Joseph Banks, President of the Royal Society. (5) Volta's monograph on the formation of hail, published about 1806. The apparatus exhibited illustrates Volta's inventions of the electrophorus and the 'electric pistol'; his application of gas to lamps, combined with an electric gas-lighting apparatus; his invention of the eudiometer; his researches on the capacity of condensers; his condensing electroscope; his investigations; on the law of electrostatic force involving the use of the electric balances and the electrometer; his researches on atmospheric electricity; his studies on the expansion of gases; his first forms of voltaic pile, including the columnar pile represented by several examples; also the 'crown of cups,' and his early experiments on electrolysis. A number of batteries of Leyden jars, electrostatic machines and other apparatus used by Volta in his experiments, while not referring to any special advancements in science, go far towards giving us an insight into the thoughts and pursuits of a physicist of a century ago of whom the people of Como feel justly proud.

ACCORDING to Reuter's agency the Governor of Algeria has received very favorable news regarding the Coppolani mission. After crossing the Niger bend and traversing the Arubruda the mission proceeded in a northeasterly direction as far as Baddab, receiving on the way the submission of several rebel tribes and entering into relations with the chief of the Awelimmiden. On returning to Timbuktu, M. Coppolani again set out with an escort composed of natives and Moors. This time he followed a northerly route. Telegrams received via Timbuktu during the last few days from him and his companion, Robert Aricand, state that they are the first two Frenchmen since René Caillie to explore that part of the country, and that they have reached Aruan, which serves as entrepot for the salt mines of Tauden. The journey through the country peopled by Moors was peacefully carried out and gave the best results.

THE Director of the Mint has issued the following figures regarding the production of gold in the United States during the year 1899:

	Gold	*Silver in fine ounces.*
Alabama	5,000	100
Alaska	2,525,800	92,400
Arizona	2,465,100	2,246,800
California	15,637,900	642,300
Colorado	23,195,300	22,815,600
Georgia	128,600	500
Idaho	1,716,900	5,073,800
Iowa	100	....
Maryland	600	....
Michigan	100	32,400
Minnesota	100	....
Montana	5,126,900	14,807,200
Nevada	2,994,500	805,000
New Mexico	539,000	425,000
North Carolina	84,000	700
Oregon	1,177,600	130,000
South Carolina	104,200	300
South Dakota	5,699,700	152,300
Tennessee	900	....
Texas	300	472,900
Utah	2,285,400	6,485,900
Virginia	4,500	...
Washington	766,200	254,400
Wyoming	5,300	100
Total	$64,463,000	54,438,000
Totals for 1897	57,363,000	53,860,000

THE annual general meeting of the Marine Biological Association was held, says *Nature*, in the rooms of the Royal Society on June 28th. The Council reported that the laboratory at Plymouth continued in a state of efficiency, and was adequately equipped with the most modern requirements for marine biological research. The investigation of the natural history of the mackerel, commenced last year by Mr. Garstang, had been continued, and a report on the variations, races and migrations of this fish had been published. A systematic study of the physical and biological conditions prevailing in the waters at the mouth of the English Channel had also been commenced, which it was hoped would throw light on the causes which determine the movements of migratory fishes. The examination of the fauna and bottom deposits between the Eddystone and Start Point had been concluded by Mr. Allen, the director of the laboratory. Seventeen naturalists and eleven students had worked in the laboratory, in addition to the members of the regular staff.

UNIVERSITY AND EDUCATIONAL NEWS.

By the will of the late Lucy Ellis, of Boston, Harvard University is given real estate and made the residuary legatee. The money is to be used for the Medical School and is said to amount to more than $100,000.

The decennial exercises of Clark University were concluded on July 10th with an address by President G. Stanley Hall and shorter addresses by Dr. W. H. P. Faunce, the newly elected President of Brown University, and Professor H. P. Bowditch, of Harvard University.

Yale University has bought, at an aggregate cost of $146,000, eight pieces of land on College Street, which it is reported will be used for the erection of an Alumni Hall. The purchase is important, because it joins the College campus with the Sheffield Scientific School.

The Senate of the University of London, at their meeting on July 5th, passed, by 21 votes to 6, the following resolution, proposed by Sir Edward Fry and seconded by Mr. Bryce: "That the Senate accepts the proposal of her Majesty's government, as far as it provides in buildings of the Imperial Institute accommodation for the work hitherto done by the University; and authorizes the committee consisting of the Chancellor, Vice-Chancellor and Sir J. G. Fitch to settle the formal terms of agreement with the government, and the Senate reserves the right of the University to hereafter request the government to make further provision for such further needs as may arise in the future."

A special conference is now being held in St. Petersburg of all the University rectors, the guardians of educational districts, and the chief inspector of all the technical schools of Russia, under the presidency of the Minister of Public Instruction, to consider what can be done to improve the situation as regards the students. The proceedings are strictly secret, but it is reported by the *Times* that they will probably result in some changes in the University statutes and regulations, giving the students more freedom. Most of the students who were in prison in St. Petersburg have been released, but they are apparently being sent out of the capital. There is no information as to what has been done with the arrested and banished students of other towns. It is felt that renewed trouble may be expected in the autumn and winter unless some radical improvement is made.

Dr. George E. MacLean, Chancellor of the University of Nebraska since 1895, has accepted the presidency of the State University of Iowa, and assumes the duties of his new position on August 1st. The vacancy caused by his retirement from the University of Nebraska will be temporarily filled by Dr. Charles E. Bessey, who will be 'Acting Chancellor' until such time as the Regents elect a Chancellor.

Dr. George T. Winston, President of the University of Texas, has sent in his resignation, to take effect September 15th next. Mr. Winston will assume the presidency of the North Carolina Agricultural and Mechanical College, at Raleigh, N. C., on October 1st. The election of a President of the University of Texas and of a successor to the late Dr. W. W. Norman, professor of animal biology, have been deferred until September.

Several changes have occurred in the mathematical department of the University of Texas. Dr. L. E. Dickson has been appointed associate professor. Dr. H. T. Benedict, of Vanderbilt University, and Mr. I. N. Putnam have been made instructors. Mr. Arthur Lefevre and Dr. M. B. Porter have resigned, the latter having been called to Yale University. In the same university Miss H. V. Whitten has been appointed tutor in geology, and Dr. James R. Bailey has been promoted to an adjunct professorship of chemistry.

The *American Geologist* states that Curtis F. Marbut, assistant professor in the Missouri State University, has been promoted to the full professorship of geology in that institution and has been granted a year's leave of absence which he will spend in study and research abroad.

Mr. J. Lewis McIntyre, a graduate of Edinburgh and of Oxford, and at present lecturer in philosophy at Aberystwyth, succeeds Mr. Stout as lecturer in comparative psychology at Aberdeen.